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CONTENTS

The Milesian Background of our Scientific Ontology: HAROLD CHAPMAN BROWN 365

A Phenomenological Interpretation of Physico-Chemical Configurations and Conscious Structures (I): OLIVER L. REISER.. 373

Book Reviews:

Burkamp's Begriff und Beziehung: A. CORNELIUS BENJAMIN..... 385

Overstreet's Influencing Human Behavior: M. C. OTTO..... 387

Patterson's Problems in Logic: C. O. WEBER..... 388

Journals and New Books..... 389

Notes and News..... 391

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THE JOURNAL OF PHILOSOPHY

THE MILESIAN BACKGROUND OF OUR SCIENTIFIC ONTOLOGY [1]

IT is a widespread and popular impression, from which not all philosophers are free, that modern science, resolving the atom into electrons and protons, is merely refining the atomic model that Democritus instituted, under the recovery of which came the great scientific achievements of the last three centuries. How little trustworthy are such impressions is well known to the historian of knowledge. That this one is no better than many of its fellows, an unbiassed inspection of the problems besetting our physicists and physical chemists will show. An interpretation of the results of such an inspection is the motive of this paper.

Classic atomism, as a model for use in what Mach and Rignano call "thought experiments," is familiar to everyone. There are certain eternal and unchanging elements, the atoms. These atoms are minute chunks of substance tied together to form a universe by forces, some quite general and external, like gravitation, others less so, like magnetism, and others specifically related to the different sorts of elements as affinities and valencies. Also, since the human mind, like nature, abhors a vacuum, there has been postulated in the interstices of these elements a curious ether stuff that can undulate and by its undulations free us from the dread spectre of action at a distance. To one who reads between the lines there is an underlying craving for atoms of a single sort, although modern atomism has been obliged to content itself with the eighty-odd chemical elements and has partially palliated this predicated pluralism by correlating atomic weights and seeking to amend its measurements in accord with Mendeleef's "Law of Octaves."

The electronic basis of the new physics is surely important to the scientist as introducting new quantitative considerations, but it need not trouble the philosopher if it indicates no fundamental change in *kind* of cosmic structure. What if the atom does become a small solar system or if Mendeleef's law does get new meaning when atomic numbers replace atomic weights in its formulation? To be sure, the many sorts of atoms are reduced to two sorts of elements, electrons

[1] Rewritten from a paper read at the Pacific Division of the American Philosophical Association, Mills College, November, 1926.

and protons, and this is a long step toward an ideal qualitative monism, but otherwise everything appears as before. There are still eternal elements and external binding forces. Ether still unctuously undulates.

But is this actually the case? The attentive reader of science finds in himself a growing suspicion that something more, perhaps something revolutionary to thinking, has occurred. He notes that the electrons and protons are called charges of negative and positive electricity and he bethinks himself that a charge of electricity is a form of energy, a force and not a substance. There is before him a new world in which energy is replacing matter. What is this new world of energies?

This is a problem of which even Poincaré, who almost a quarter of a century ago pointed out the radical changes threatening the "physics of principles," completely ignored the ontological significance. It would, of course, be purely mythical to construct an ontology of disembodied energies. Energy means capacity to do work. This seems to imply both something working and something worked upon. What we actually observe is that when a change manifests itself in a certain identifiable region of space-time (e.g., a match head is subjected to friction), there also occur changes in other identifiable regions of space-time (e.g., the match bursts into flame), correlatable, as Hume reported, because of a "constant conjunction." Since no word has meaning except in relation to certain facts, situations, or human attitudes that it serves to single out for attention or denotes, and since words derive meanings solely from the characteristics, their denotation exhibits when experienced (tried out), we must derive the meanings of the terms "matter" and "energy" from our experience of situations such as has been depicted above.

The first fact leading to this derivation is that limited regions of space-time often have more or less clearly distinguishable qualitative characteristics that tend to persist through time and have a relatively constant extent, or, if changing, do so in an orderly and gradual fashion. Colors fade, shapes alter, and sizes wax or wane. The term "physical object" is used to mean just such extended, qualitative, space-time regions. But it is burdened with ambiguity. There are certain of these regions within which our unaided senses distinguish no subordinated, separated, and differentiated space-time regions. These we call unhesitatingly physical objects. Such are a chair, a mountain, or a grain of sand. Scientific indirect observation, however, leads us to recognize that these regions are analyzable into smaller regions having themselves the characteristics giving claim to the title "physical object." If we acknowledge this claim, the last discriminated regions, the electron and proton, become the

real physical objects, and if we continue to designate structures compounded of them as also physical objects, we can hardly refuse to call our solar system, or the stellar universe of the milky way, physical objects. That is, the concept of the physical object has taken on a new meaning: it no longer denotes the character of a region as such, but of the "totality-effect" of a region. Thus the same region may be viewed sometimes as an object, when we look toward its totality-effect, and sometimes as an aggregate of objects when we consider the properties of its separable sub-regions themselves treated as objects.

Also there is another sort of vagueness that characterizes the idea of the physical object due to the demand that it shall have a certain degree of duration in time. We are disturbed by minimal degrees of duration. A mouse or a mountain may be recognized as physical objects however different the lengths of their temporal persistence, but how about a lightning flash or a puff of smoke? Mr. Broad would insist on some limited, although vaguely defined, durational extent (Broad, *Mind and Its Place in Nature,* p. 146), but I can see no good reason for this restriction. Just as metaphysically we may transcend the limits of our perceptive grasp to accept the cosmos and the atom as physical objects, so we can also transcend the limitations of our perceptive time-span and accept the flash and the puff as objects, as it would surely be expedient for the student of flashes or puffs to do.

Our next observations bring to light the fact that changes taking place in physical objects, as defined above, rarely even seem to occur in isolation and the success of science in asserting that they never so occur has been such that we have come to accept this as a methodological postulate. In the idea of causation we record our experience that changes in different physical objects can be correlated as to order and kind, and from the observed fact that we can select unit equivalent causes and correlate their joint effects with the effect of certain other causes, usually of the same kind, we develop and apply the idea of quantity. A further generalization of the idea of quantitative equivalents among causes constitutes the idea of energy, for the assertion of a "capacity to do work" is merely a recording of the fact that a quantitative equivalence exists between changes taking place in a physical object somewhere and subsequent changes in another physical object elsewhere.

The idea of physical objects as specially separated arises because the observed loci of cause and effect changes are often qualitatively characterized and more or less delimitable in spacial terms, and the between regions, to our perceptive capacities, often *appear* empty. But just as the indirect observational methods of science compel us

to transcend perceptional limitations in extending the concept of the physical object to the atom and the solar system, so we have been compelled to recognize energy conditions in the interstices between physical objects that correlate with, and so are not independent of, the conditions of the physical objects themselves. When do light conditions cease to belong to the emitting object and become mere emitted rays? We can only reply that, as we examine the energy conditions that give rise to the effects we denote as spatial, there are certain critical points where a marked change of energy conditions is manifest. Thus at the boundary of what we call a solid the energy of momentum of another solid is replaced by an energy of heat beyond the boundary, and under the influence of light rays, color qualities are exhibited. The separateness of the object is then merely a name for the fact of the occurrence of such localized, striking energy transformations.

Here again transcending perceptual limitations introduces a sort of relativity. The puff of smoke object is not clearly delimited to sense, and perhaps this fact contributes to our hesitancy in admitting it as an object, but to an X-ray or to a wandering electron the end of a ruler would present a similar nebulosity. There is no mathematical plane such that on one side of it these things could be said to be in "empty" space and on the other within the ruler. Consequently, spatially the distinction between a physical object and the surrounding space is like that between a mountain and the terrane out of which it arises. Both are the same sort of stuff, but differ only in the qualitative and quantitative aspects of their formations.

That skeleton in the physicist's closet, the ether, that "mere substantive to supply a subject to the verb 'to undulate,' " now takes on a new meaning as a πρώτη ὕλη which under its new title "space-time" serves to bind physical reality together and reassert its fundamental unity as a primitive *physis* giving rise to space, time, matter, and their attendant effects. Physical science has come to be limited to discrimination, description, and causal correlation of these effects as they may be brought to manifest themselves to direct or indirect observation. We have not yet, and perhaps never can, bring them into a single comprehensive system. There is no reason to suppose that gravitational conditions affect the electric conductivity of a wire. As long as this can not be shown it is possible to conceive of the basic *physis* as having a plurality of change tendencies that by their interactions give rise to the world of which we find ourselves a part. It is possible, however, that the electro-magnetic conception of matter may succeed in including the more or less obscure conditions of gravitation or that both may be subsumed under some more general conception that can exhibit in the *physis* a single type of change-

tendency to which the whole diversity of energy conditions might be correlative. In this case we should have a true metaphysical monism, the "one God, one law, one element" of the idealists, only, I fear me, the God, the law, and the element would not be very acceptible to our Idealist friends, for the God, although omnipotent, would not be intelligent; the law, if directional, would not be purposive; and the element, although one, would not be spirit.

In this dynamic conception of matter, the stuff of physical objects, what has become of the eternal existence of the elements? In the shock of discovering that our atoms are divisible and may be generated or perish, the first thought is to transfer their permanence to their constituent electrons and protons, and there is some evidence that these are not likely to turn out to be divisible in the same sense as the atoms. But this is cold comfort, for it is asserted by physicists that when an electron jumps from an outer to an inner orbit within the atom there is no ground for even assuming its existence during transit. Also there is good experimental evidence suggesting that the somewhat more mysterious *quanta* can vanish and reappear: e.g., quanta, energy units, i.e., units of capacity to do work, when shot through the dark bands of a diffraction spectrum, have no capacity to do work during their passage through these bands. They lose the very quality that justifies us in considering them as existences. It is of no use to appeal to the laws of the conservation of mass or of the conservation of energy, for mass has disappeared in electro-dynamic inertia varying with velocity, and energy has become a diffused phenomena of concrete extension within which, as Poincaré pointed out, the conservation of energy means nothing because it foretells nothing. (Poincaré, *Value of Science*, Ch. VIII, No. 4.) The quanta here, as the electrons in the case cited above, may as well be thought to vanish in one place and be reconstituted elsewhere.

Just as the present elements are probably not eternal existences, they are also not independent existences. This is more difficult to make clear since scientific thinkers have never constructed very adequate thought models for such processes as simple attraction and repulsion. The only relatively satisfactory effort of which I am aware is in connection with Einstein's gravitational hypothesis where gravitation is conceived as a resultant of the total energy conditions of the space-time field. At least one would expect a rather subtle relation of dependence between electrons and protons for we could hardly think of either coming into or passing out of existence without a corresponding emergence or demergence of its correlate. Also the curious "feel" that an electron seems to have of a vacancy in another possible orbit within the atom and which it leaps to fill, simultaneously knocking out a quantum, implies a kind of inter-

dependence among these entities not paralleled in a system of atoms tied together by external forces. Furthermore, if Professor G. E. Lewis is correct in his assertion that a quantum is never emitted unless there is an atom, or will be at the time of its arrival, in a suitable place to receive it, the independence of these elementary physical objects goes by the board.

These observations of modern physics, so apparently paradoxical on the basis of atomic materialism, are in a natural harmony with the *physis* concept of the Milesians. F. M. Cornford (*From Religion to Philosophy,* p. 136) has called attention to the similarity of this concept to that of the ether, but the resemblance to the relativists' dynamic space-time is even more striking. This space-time is a real *physis* since it gives rise to the phenomena of space, time, matter, and motion. It possesses within itself an inner principle of activity and, never being really divided, it holds the world together. But where the Milesians did not investigate the natural properties of water, air, or fire because "these were merely gross vehicles of the primary soul-substance on which their attention is fixed" (Cornford, *loc. cit.,* p. 129), the modern physicist seeks to derive the properties of the *physis* as the condition making possible its specific manifestations.

We must not be confused by the modern interpretation that has described Milesian thought as Hylozoism. Milesian thought was articulated before the distinction between the living and non-living, or between the soul and the body, had been clearly formulated. It would be an anachronism to ascribe to them the logical error of attributing to the world as a whole the special character of a particular part, for the differentiation of the part had not yet been rendered clear. It would, of course, be pure confusion of thought when one has come to look upon life as a very special synthesis of specific energy manifestations and differentiated it through this peculiar specificity, to attribute to the universe this special character occurring within it, very much as if we should assign to the whole organism the peculiar characteristics of some highly differentiated cell because that cell was derived by the differentiation of general protoplasmic structure under the influence of other differentiating protoplasmic structures within it. The cosmos is a changing whole, but lives only in a figurative sense.

Ancient Greek hylozoism failed by unfaithfulness to its fundamental monism under pressure to get in touch with the concrete facts of experience. If things really detached themselves from the fundamental *physis* in "separating out," they were nowhere, since the *physis* was fundamentally spatial; and if, somewhere, they must remain within the *physis* with no empty space between, hence not separated out. Thus having arisen by an abjuration of the monism

of the *physis,* they could not reenter a universe of monistically related movements. Hence it was not difficult for Parmenides and his followers to elaborate the contradictions involved. Efforts to overcome these contradictions were fruitful, for they resulted in the atomism of Democritus, but although this conception might save the day for the experimentalists of later generations, it has never really conquered the fundamental contradiction, as idealistic philosophers have seen.

The revived *physis* concept, however, offers another means of escape. If the physical object is nothing but a spacial region that manifests certain differentiating energy conditions, the movement of such a body can well be conceived as a travelling of these energy conditions, like a wave on the sea or a knot on a twisted cord. There is no need of empty space. Nor is it necessary to conceive even "elemental" objects as having eternal existence. The quantum, a unit capacity to do work, that can do no work while passing through the dark band of the diffraction spectrum, might well be a spacially delimited energy condition that looses its characteristic spacial delimitations in a certain kind of energy field and, continuing in a diffused form, re-develops a correspondin- spatially delimited condition that replaces it beyond; or, again, the very energy condition of the space-time field that starts a quantum loose from a specific region might be a diffused aspect of the identical condition that prepares the place at which the quantum is to arrive and that controls its course.

From the modern *physis,* as from that of Anaximander, things are derived by separating out, but with this difference: their separation is that of differentiated aspects of the *physis* and not of parts spatially removed, and it is not merely space, time, and motion that are aspects, but matter itself. Where for the Greek things lost their participation in the original oneness by the separation, for the modern they retain it substantially and differentiate only by the kind of activity they exhibit. And even this activity is not their private possession, but is a sort of phase of the more general activity that appears as correlative changes, not only in other differentiated entities, but also in the rest of the *physis,* "ether waves," "lines of force," etc.

The conflict generated by the Milesian inability to give a coherent account of the process of separating out underlies all subsequent philosophy from Parmenides' distinction between the "way of truth" and the "way of opinion." Idealists, by holding fast to oneness, made spiritual by a misinterpretation of the Greek model, have been forced to dialectic obscurantism in an effort to get in touch with the world we live in. Materialists, by emphasis on the specificity of

things, have told us far more about the physical world, but since their starting point has been atomistic pluralism, they could only recover the necessary unity to make a world by an hypostatization of the mechanics of external forces, like gravitation, or mathematical equations, like Laplace's, and by reducing things of sense to mere appearances of atomic complexes and the aspirational aspects of life to empty sham.

It is only, it seems to me, by a reconstruction of the Milesian *physis* that this contradiction can be overcome, that we can understand both the unity and the diversity of the real. For it only, can the desk be as real as the atoms or electrons into which it can be analyzed, or acts of love, fear, and jealousy, as real as the fall of an apple. Emergent evolution has recently attempted to solve the problem by a consideration of progressive syntheses, but fails to meet the difficulty of accounting for the new properties of each more complex level except by the assertion that they emerge. To the modern hylozoist, the procedure is the reverse. For him a whole is a reality with all its characteristics and its separation into constituents is attained by an analytic discrimination of aspects of it which seem to be always concurrent with that of its character as a whole. This is the real procedure of the scientist who forgets the character of the diamond as such to study the relations of its molecules and their structure. Analytic omission does not involve the same difficulties as synthetic addition.

If it is a question of a name for this revived Milesian ontology neither idealism nor materialism is quite adequate. Idealism must surely be rejected as implying an underlying spiritual unity that is contrary to fact, in spite of the dialecticians. Materialism is objectionable both from its implication of the merely phenomenal character of everything except the atoms and its association with the formal mechanisms of bodies in motion. But these difficulties are not of the same order as those that confront the use of the term "idealism." If the *physis* concept transcends that of independent atoms and external forces, it is only by incorporating them in a wider concept, and it has attained this result by the same method of descriptive correlation and the derivation of the meanings of its terms from the observed characteristics of the denoted facts by which atomistic materialism prospered. The alternative, then, is to coin a new name that will lack connotative contact with the progress of the past, or to preserve the sense of historical descent in the term "materialism," recognizing in this the meaning, always implicit, of an ontology based on the most thorough-going physical investigations of the time. I prefer the latter alternative.

STANFORD UNIVERSITY. HAROLD CHAPMAN BROWN.

A PHENOMENOLOGICAL INTERPRETATION OF PHYSICO-CHEMICAL CONFIGURATIONS AND CONSCIOUS STRUCTURES

PART I

I. Emergence, *Gestalt* Theory, and Phenomenology

ONE of the most notable features about the development of the sciences is the acceleration in the accumulation of an almost overwhelming mass of detailed facts. Along with this has gone an increasing difficulty in the synthesizing of these facts into meaningful systems of knowledge. In enlarging the sphere of knowledge by the discovery of new facts science has certainly made progress; but, in a broader sense, science, in enlarging the inner boundary of the unknown, has not made progress towards ultimate explanation. There seems here in the intellectual sphere to be the same instability between perfect symmetry and maximum density of atomic facts which obtains in the physical world for particles in space loci. Even in physics, that most fundamental of natural sciences, where the Einsteinian doctrine of relativity has served to unify the facts of the material universe, there still remain outside the static picture of the four-dimensional space-time continuum all those facts of a dynamical world lying at the basis of quantum mechanics. And in biology, where the doctrine of evolution (of a dynamic world) originally promised to play the same rôle which relativity now plays in physics, there lingers outside the whole of the science of genetics (a static picture) still unassimilated into evolutionary interpretation. In view of this eccentric path of progress in scientific advance those of us who regard the privilege of philosophers as being that of integrating the facts of science into our world-views may well ask ourselves, what is to be done?

As a possible method of integrating the vast masses of facts of science into meaningful wholes the writer wishes to propose the adoption of a phenomenological viewpoint in science. Much of the trouble, it seems to me, comes from an overemphasis upon microscopic details. It is literally true that we can no longer see the forest for the trees. I therefore suggest that philosophers ascend in balloons and view the forest and ignore the trees. I do not know what term a Freudian would invoke to describe this flight, but it is interesting to note that scientists themselves occasionally turn to this point of view.[1] Perhaps it is unnecessary to point out that

[1] By phenomenology I mean a study of that which displays or exhibits itself. A phenomenological presentation is a pattern given in perception. I do not wish to get tangled up in the epistemological dispute concerning the status of phenomena, percepts, perspectives, essences, etc. (Note continued on p. 374.)

physical chemistry, in employing the second law of thermodynamics, resorts to the phenomenological method. Certainly those who have followed the development of *gestalt* theory have seen it creep into the field of psychology. And now biologists, if they follow a suggestion of J. B. S. Haldane,[2] will occasionally abandon their microscopic spectacles and examine nature from the higher point of view. This eminent biologist states that, "To my mind the closest analogy to the evolution of a given group (of animals) is the history of the art and the literature of a civilization."

Another illustration of this viewpoint presents itself in the study of botany. We may view a flower as a phenomenal pattern—the attitude of appreciation; or like the biochemist who studies the intimate mechanisms, we may analyze the petals of the flowers into their intricate molecular structures. But we must never forget that the flower, in spite of its detailed complexity, possesses a phenomenal simplicity which is responsible for its beauty to us. If we thus view the productions of nature as works of art, the pleasant task of philosophy becomes that of enjoying the harmonies and melodies of nature's music, leaving to the psychobiologist the measurement of the basilar membrane and cortical functions, to the acoustical scientist the dissection of the sound waves, and to the mathematician the discovery of the numerical values of the components of the corresponding Fourier's series.

The adoption of the phenomenological viewpoint, as interpreted in the present scheme, seems to possess the following merits: (1) It gives us some understanding of the *raison d'être* of emergence. This doctrine of emergence is frequently used as a panacea for all philosophical ills. Since novelties are unpredictable emergence leads to an abandonment of explanation. I do not deny the facts underlying the doctrine of emergence, but reinterpret them in a phenomenological fashion. (2) A second advantage of this viewpoint is that it enables us to escape an unbridgeable dualism of the physical and the psychical. In the present phenomenological view "matter" and "consciousness" exhibit themselves as correlative aspects of configu-

In preceding articles elsewhere I have vacillated between a form of epistemological monism in which the secondary qualities of the object are held to be *both* subjective and objective, and a view in which the subjective configurations, embodying patterns of conscious qualities, are regarded as being in *attunement* with the objective configurations. By attunement is meant a similar sort of synchronism of temporal relation (or "chronaxy") which Lapicque has shown to hold between the central nervous mechanism and the musculature. But in either interpretation the objective pattern is independent of the conscious structure of the perceiving subject. In this sense the present phenomenology is realistic. I may add that I am not consciously following the phenomenological method of Husserl.

[2] *Forum*, Feb. 1927, p. 63.

rations which, viewed from a microscopic perspective, appear as physical, and from the macroscopic viewpoint appear as endowed with mind or consciousness. It is by continuing this particular line of thought that I propose to introduce my thesis.

While the distinction between soul and body is an old one, unlike many other ancient ideas it has not passed away. The dualism of consciousness and nervous processes has maintained itself against the assaults of present-day monistic systems. Some of the more recent dualisms have sought to reënforce their position by stating this dualism in terms of the alleged difference between the experienced time of living beings and the measured (spatialized) time of physics. Bergson is the most prominent philosophical advocate of this view. In science this doctrine has recently been presented by Gilbert N. Lewis in his *The Anatomy of Science*. Professor Lewis is also in accord with Bergson's doctrine that living beings are cheats in the game of entropy. This absolute break in nature between time as experienced and time as considered in physics is also argued for by W. H. Sheldon in his paper on "The Spirituality of Time." [3] On the other hand, it seems to me that the *gestalt* psychologists and A. N. Whitehead have at least this much in common, namely, that psychical time and physical time are regarded as continuous with each other. This is the view which I also propose to defend.

In an article elsewhere [4] the writer has tried to show that entelechy or the vital impetus can not violate the second law of thermodynamics. To the contrary, every investigator who makes this distinction between conscious time and physical time, and who further regards living organisms as being capable of suspending the second law of energetics (Bergson, Driesch, Lewis, *et al.*) seems to me to be guilty of an inconsistency. Consciousness is somehow tied to physiological brain processes, and the only biochemical process which can provide the irreversible underpining of the irreversibility of experienced time is the second law of thermodynamics.

The idea therein presented is that the supposed dualism between the physical and the psychical is only a dualism between two kinds of simplicities in nature. The view that conscious structures are simplicities of the second order (complex simplicities) as contrasted with the first order (or simple) simplicities of "physical" realities is related to the second law of thermodynamics. The irreversibility of subjective time then becomes a special case of the unidirectional character of the second law of thermodynamics, which, in its gener-

[3] This JOURNAL, Vol. XXIII (1926), pp. 141–154.

[4] "Probability, Natural Law, and Purpose," this JOURNAL, Vol. XXIII (1926), pp. 421–434.

alized form, refers to the averaging process by means of which a macroscopic or phenomenal state is produced. I am indebted to Professor K. Koffka for the suggestion that these two kinds of simplicities in nature are illustrated by (*a*) the simplicity of a gas, which is homogeneous, and isotropic in its space dimensions, and (*b*) the simplicity of a crystal, which is inhomogeneous and anisotropic. In esthetics the second-order simplicities are known as unity-in-variety. *Nature apparently is not satisfied with the first level of simplicity, but always strives to attain the second level of simplicity.*

The belief is growing that the value of the phenomenological viewpoint has been underestimated in physico-chemical science. If this is correct there is no need to create the rift in nature which Professor Lewis makes. He, in fact, almost comes upon this interpretation of emergent evolution in the following passage: "The interaction between two bodies is treated by the methods of mechanics; the interaction of a billion such bodies must be treated by the methods of thermodynamics. These are the same bodies and presumably follow the same behavior, but a great group of new phenomena *emerges* when we study an immense number . . . " (p. 184). Unfortunately, Professor Lewis does not follow up this interpretation of life as an emergent in evolution, but, to the contrary, holds that life is a cheat in the game of chance. In opposition to this view I propose to use the second law as the basis of conscious purpose in organisms.

This view that *emergents* are only "central tendencies" of statistical distributions of microscopic elements, and that the macroscopic state *is* the phenomenal configuration of present-day *gestalt* psychology not only involves a reinterpretation of the notion of "matter," but it also implies an extension of the second law. The tendency to achieve second level complexities may be explained by construing the second law to mean the tendency to reduce the free (potential) energy of a system to a minimum. As illustrative of the application of this view we have the averaging process, which is responsible for the seeming continuity of such an elastic medium as water. Again, air is sometimes considered as an elastic medium since it transmits sound "waves"—and yet we know that further detailed analysis shows that these media are composed of discrete particles. In the case of water no difference can be observed between the phenomena predicted on the basis of a mathematics of continuous quantities (calculus) and the empirically demonstrated facts. In these cases a large number of discontinuous elements in an averaged or macroscopic state produce a seeming plenum, the description of the behavior of which requires a dynamics of the

continuous. Is it possible that the miraculous properties of all emergents lie in this process by means of which the novel properties of water result? (The chemists are well on the way towards explaining the "wetness" of water.) This process whereby discrete particles produce continua, in which wave motions are possible, seems to me so notable that I should be willing to say that such phenomena may be designated as new "dimensions" (figuratively speaking). In this case we should be quite in line with that type of speculation which describes consciousness as a new dimension.

But it will be argued by some that while this may be true of our perceptions of physical realities—resulting, perhaps, from the fact that sensory analysis is not fine enough to discriminate the discontinuous elements (a limitation of the time-sense, as E. B. Holt calls it)—this does not hold for the unity of consciousness. But even here, it seems to me, the continuity of the "specious present" of experience, as it advances through the psycho-physical continuum, represents a "wave" in the stream of consciousness. The properties of this wave constitute a macroscopic state (a macropsychic rhythm I have termed it elsewhere), arising from an averaging of microscopic elements. Consciousness may come in drops, as William James says, but let us not forget that "drops" are again composed of molecules. The writer[5] outlined this idea when he suggested that the continuity of movement (and of consciousness) which is given in such a motion as a sweep of the arm through the air (Bergson's illustration, I believe) is the averaging effect of a number of "all or none" pulses in the nerve and muscle cells. Finally, to complete this preliminary survey of the general point of view to be presented, may it be suggested that the unity of any bit of "matter" may be analogous to the unity of a chorus of voices directed by a conductor? What the conductor is I shall surmise later.

II. Wave Motion as a Phenomenological Pattern

Since rhythms and wave motions are taken as typical illustrations of phenomenally emergent patterns, some consideration must be given to certain possible objections based on the following line of reasoning: It may be argued that there is no such reality as an acoustical medium. *Air*, as a continuous fluid, is a fiction. (I first became acquainted with this argument through Professor Lunn of the University of Chicago.) All that exists is the molecules of the various "gases" colliding with one another. Air, like ether, as a medium, was created for the purpose of explaining undulations or

[5] "An Electromagnetic Theory of Matter, Life, and Mind," *Monist*. Vol. XXXIII, (1925), pp. 605–633.

wave motions. But the wave itself is only a mathematical fiction which is supposed to move along as a kind of geometrical plane, representing an averaging effect of the orderly molecular displacements. Perhaps even the interference effects of light, which now seem to require a continuous medium, the ether of space, for their explanation, may some day be understood as statistical effects—provided the statistical units can be assumed to be sufficiently small.

In reply to this argument I may say that a theory of waves based upon an averaging effect of statistical units is quite in line with the view here presented. However, the existence of fields of force associated with material particles is equally essential to this view for the fields of force connected with electrons, atoms, and molecules iron out the discontinuities in the averaging processes. According to this view every "material" pattern has associated with it an invisible (and perhaps by its very nature *unseeable*) field of radiant energy. The field of force, in smoothing out the curve of the averaged molecular displacement which is the "wave," here plays the same rôle which the derivative plays in the equation which describes the curve.

Next I wish to make clear the two principles which I shall take as the basis for a philosophy of nature.

III. Potential Energy and the Principle of Least Action

If we disregard the infinite number of minute facts of the sciences and confine ourselves to principles it will be observed that there are two principles which are quite generally held to be universally applicable throughout the sciences. These two principles are popularly termed:

(*a*) The Principle of the Conservation of Energy
(*b*) The Principle of the Degradation of Energy

I shall base a whole philosophy of science upon these two principles of energetics (or thermodynamics), arguing that they are entirely adequate to describe every phenomenon of inorganic and organic nature. But I shall interpret these two principles in the following way: The principle of the conservation of energy is to be regarded as a special case of a broader principle termed the *principle of least action.*[6]

The principle of the degradation of energy or the second law of

[6] The relation between the principle of the conservation of energy and the principle of least action is stated in Max Planck's *Survey of Physics.* In his *Space, Time and Gravitation,* A. S. Eddington tells us (p. 149) that all physical phenomena converge to the two great generalizations, the principle of least action and the second law of thermodynamics.

energetics is variously interpreted as expressing (*a*) the tendency of energy to become unavailable through radiation of heat energy out into the depths of space, or (*b*) the tendency towards an increase of entropy to a maximum, or (*c*) the tendency towards a mixed-upness of the motions of the molecules composing the system under observation. Each of these interpretations is only another way of summarizing the same set of facts. If heat is proportional to the average kinetic energy of the molecules, the hotter the gas, liquid, or solid the greater is the average number of collisions per unit interval of time, and the shorter is the mean free path between impacts. According to the second law this tendency will distribute itself uniformly throughout a system—unless there is some Maxwellian "sorting demon" who can distinguish and separate into compartments the rapidly moving from the slowly moving particles. One interpretation of the second law construes it to mean that the potential energy of the system tends to be reduced to a minimum. (I shall use the term "potential energy" as synonymous with "free" energy, or energy available for doing work.) If the equilibrium of a system possessing a supply of potential energy is disturbed the resulting process will continue until all the available free energy has been used up. In other words, the system will continue to change until it reaches a point where it will oppose further change, provided no additional energy from without is added. *Thus this principle may be stated as a principle of maximum action.* (I use the term "maximum action" rather than Nernst's term *"maximum work,"* because I am not sure that my meaning coincides with the meaning now ascribed to the principle of maximum work.)

We have, then, two principles: a principle of least action and a principle of greatest or maximum action. These two principles do not conflict with each other. The second principle states that if the equilibrium of a system possessing a fund of potential energy is disturbed the resulting process will come to rest only after the potential energy has been reduced to a minimum (of course, under the constraining conditions to which the system is subject); while the principle of least action states that in passing from an earlier to a later stage the sequence through which the system passes is such that the mean or average value of the difference between the potential and kinetic energies during the interval of time of the change will be a minimum.

Several differences between these two laws are recognized: the second law of energetics is regarded as a statistical law, whereas the first law is regarded as non-statistical (i.e., a causal or dynamical law); and secondly, the second law is concerned with irreversible processes, whereas the principle of least action is applicable to re-

versible phenomena. (I suspect that in the view herein presented it ought to be possible to reduce these two laws to one.)

Since I am considering atoms, molecules, and crystals as being on the same level with organic behavior, we now need an introductory illustration of the way in which these laws are responsible for purposive behavior in organisms. Taking as the most suitable example that of purposive behavior in human beings, is it not evident that our interpretation of the second law disposes of the difficulty which many have felt with the statement that human beings always take the line of least resistance? Human activity represents a compromise between *two* principles, a conservative principle of least action, which, if obeyed absolutely, would result in laziness and monotony of conduct, and a principle of greatest energy expenditure, or the tendency to use up the store of available potential energy by seeking out and reacting to new stimuli. *Through a period of time we tend to react to the most complicated environment which we can meaningfully simplify.* This is the esthetic unity-in-variety which, in a musical composition, for example, characterizes a great symphony. Professor Koffka has shown how it is also illustrated in visual perception by the law of "greatest horopter." In the field of moral conduct it is perfectly obvious that in making choices we frequently, out of a "sense of duty," choose that line of action which involves a greater expenditure than the alternative course of action. And yet here a simplicity or a moral order of unity, and a conservation of "spiritual" energy, is secured.

We thus find human conduct giving release to the energies of human nature, and this appears as an expression of the tendency of a system to reduce its potential energy to a minimum. And, still further, the irreversibility of conscious purpose and experienced time has for its physiological condition those electro-chemical processes in the brain which can be described by the unidirectional character of the second law of thermodynamics.

IV. A Phenomenological Interpretation of Matter

The possibility of writing a text-book of physics from a phenomenological viewpoint has long fascinated me. In this system of physics we would not be studying the laws of metaphysical entities, such as hypothetical electrons, but we would be studying the uniformities of sequences of *images* or phenomenological patterns. Electrons, however, would not be excluded, provided they, too, were regarded as patterns or images. In such a science we would preserve all that is now accepted, only that we would give to these phenomena a different interpretation. All that we would have to specify is that the laws according to which these

images approach or succeed one another are exactly the laws as now formulated. Thus, in studying the law of falling bodies, all that we need specify is that the law according to which one image, a book, approaches another image, the earth, is precisely the law $S = \frac{1}{2}gt^2$. It is obvious that if we interpret the *image* to be an objective *gestalt,* this view is not Berkeleyan idealism.

The following emergents I shall regard as constituting distinct levels, to which our two laws must be applied:

(*a*) Electrons and Protons
(*b*) Atoms
(*c*) Molecules
(*d*) Crystals
(*e*) Individual Cells
(*f*) Multicellular Organisms

I wish first to suggest how a phenomenological view may be applied to each of these emergents, and then to draw some general conclusions concerning the philosophy of evolution which seems to follow from such a view. But before proceeding to a phenomenological interpretation of matter there are two correlative ideas to be stated which need to be kept in mind in discussing each of these emergents.

(*A*) While the phenomenal unity of an emergent (or a *continuant*) is that of a statistical average, this does not mean that *chance* is the factor which produces it. When we ascribe the macroscopic unity of an object to an averaging process this simply means that the causal law governing the synthesis of this unity is not stated. Moreover, the relation between the true unity of behavior (or substantiality) of one type of object is relative to the statistical unity of another. That is, when acting as an element in molecular configurations the atom acts as an integral or unitary entity. Molecules also, in individual phenomena, maintain their self-identity. And yet both may enter into processes where their identity is lost (if viewed from a "higher" point of view), and, as in the phenomenal continuity of water, become parts of macroscopic states.

(*B*) A fact which has always puzzled me is that nature is never satisfied with the level she has achieved (even when it is a complex simplicity, such as a molecule or crystal) but always aspires to higher levels. Whatever the explanation, this fact of the creative restlessness of nature results in this situation: *the probability within one continuant is discontinuous with the probability of another.* For example, the probability considerations which hold for the averaged state which gives the unity of a crystal are discontinuous with (and can not be deduced from) the probabilities holding within the field of molecular phenomena. When a jump is made from one level to another a new coördinating force enters.

The difference between any two levels I shall describe as follows: Within molecular phenomena (for instance), which are not synthesized into higher continuants, *inferior random forces* are at work. When the molecules are arranged in a *significant form*, such as a crystal, a *superior coördinating force* is operative. As illustrations of such superior coördinating forces we have the self-identity of such dynamic syntheses as a whirlpool in a fluid, or a vortex-ring of smoke, or the lines of magnetic force which are responsible for the orientation of iron filings. In each of these cases the superior coördinating force is associated with the phenomenal or macroscopic state or rhythm, and the microscopic elements (molecules) are real entities regarded as discrete particles with motions of their own. But, in turn, each particle is not a bit of matter in the traditional materialistic sense, but is itself a phenomenal state or macroscopic rhythm, i.e., a continuant of sub-elements. Whether the ultimate (?) elements of matter are phenomenal images in our sense of the term remains to be determined. Let us now turn to this problem of the ultimate elements as macroscopic syntheses.[7]

When we demand a phenomenological picture of an electron we ask for a view in which the old notion of a particle of matter, self-identical through time and occupying a sharply delimited region of space, be supplanted by a dynamic picture in which the self-identity results from an averaging process taken over a relatively long period of time. Such a view has been suggested by Dr. A. N. Whitehead in his *Science and the Modern World*, where he regards the electron as the periodic ebb and flow of an underlying energy. Along somewhat the same lines we have the intermittence theory of radiation presented by Sir J. J. Thomson.[8] Here Sir Joseph di-

[7] It seems to me that philosophy has more to learn from physics than from psychology. Especially is this true in connection with the new quantum mechanics. In the *new* quantum theory as developed by Heisenberg we have, in the demand that every theoretical construct must express some *observable* property of the atom, an approximation to a phenomenological viewpoint. Schrödinger's wave mechanics describes the same facts as Heisenberg's theory, but the atom is not thought of as a set of particles, but as expressing the density of electrical energy manifesting itself in the waves in the configuration-space. Either of these views could be assimilated into the present view, but if some synthesis could show that the opposition between the wave theory, where continuity is emphasized, and the matrix mechanics, where discontinuity enters, is only a difference in viewpoint associated with a differentiation of statistical and non-statistical perspectives we might have here a basic physical analogy for the view generalized in the present paper. The tendency to regard time as a statistical concept, and to recognize discontinuities in probabilities, would seem to justify this statement. In this connecton I may refer to a paper by Jordan on "Kausalität und Statistik in der modernen Physic," which appears in *Die Naturwissenschaften*, 1927, pp. 105–110.

[8] *Nature*, 1926, 606 ff.

rects attention to the possibility of electric force being intermittent in its action. Just as a gas, which on an "engineering" scale seems to exert a continuous pressure, has a structure in time, the fineness of which is determined by the interval between collisions, so we may suppose that the electric field has a structure in time. While this view implies a corpuscular theory of light, what distinguishes Thomson's theory from the work of all other writers on the subject is that he pictures the structure of light-quanta in terms of tubes of electric force. I do not presume to pass judgment upon the validity of such views, but cite them as illustrations of the doctrine that continuity and discreteness in our "material" universe are relative to our fineness of discrimination, and that averaging processes bring out qualities in the phenomenal state which are not evident in the microscopic events or elements.

If this is granted it becomes evident that the unity of an electron may be that of a statistical invariant. That is, we might suppose that the electron is made of sub-electrons, and that these entities have their existence in time, i.e., have a definite periodicity, and that the macroscopic rhythm of the electron is the averaging out of the ingressions (or entrances into space) and egressions (or exits out of existence) of the elements out of which the electron is composed. On the average there will be an equal number of sub-events coming into existence as are going out of space-time. The unity or substantiality of the electron then becomes that of a chorus of voices following a conductor. Just as it takes the hydrogen atom a definite interval of time to *be* a hydrogen atom, which is the time it takes for an electron to revolve around the nucleus, so it takes an electron a finite, though perhaps very small, interval of time to *be* an electron. Moreover, a definite velocity is required for the revolution of the electron around the nucleus, else the atom as a whole would collapse. The self-identity of any continuant is somehow maintained by the mechanism of the emergent as a whole. If the same principle applies to the electron (i.e., granting the very doubtful proposition, that the electron is still further divisible), we see that there is some superior coördinating force (the "conductor") maintaining the individuality of the electron. If this is conceded no more is required to prove the case for a phenomenological interpretation. Every aggregate of matter in the universe becomes a synthesis of micro-movements; and if there is some relation between all the movements of nature, as is assumed in views which demand a reciprocal convertability of matter and radiant (or electro-magnetic) energy, the proper symbol for this is the Oriental symbol for Eternity—a serpent swallowing its own tail!

It is also obvious that if mind is this phenomenal unity of "mat-

ter" it is correct to say that the molecule is conscious of its own atoms, just as the atom is conscious of its own electrons. That is, every emergent is conscious of its own "body"; though the converse relation does not hold. This, it will be noted, does not exclude degrees of consciousness, provided consciousness is a correlate of the time-system of any continuant of nature, and provided the rhythm of duration of a human being is different from the macroscopic rhythm of the atom, crystal, or cell. A materialistic or mechanistic system would be one in which the rhythms of human duration (such as, in a phenomenology of *seen* movement, the Wertheimer and Korte laws) were deducible from the rhythms of the ultimate elements of nature. But this is not possible. The phenomenon of seen movement, which started recent *gestalt* psychology on its way, can not be deduced from the velocity patterns which enable atoms to maintain their phenomenal identity. Nature, therefore, is not mechanical; the emergents of nature are organismic continuants.

On other occasions I have argued that the pervasive dualisms between mind and body, life and protoplasm, and energy and matter, are only special cases of a dualism of the functional unity of the whole and the relatively static entities of the sub-continuants. Furthermore, I regard this functional unity as the expression of the dynamic pattern associated with the electro-magnetic field of force or field of radiant energy. In order to demonstrate this thesis that this environing field of energy is the superior coördinating force it is necessary to show that the atom is something more than the elements out of which it is made, and that the "something more" is the field of energy which makes the atom a phenomenal object. In support of this view we may employ the illustration which Professor J. H. Jeans [9] has suggested of a hypothetical universe containing only two material constituents, a negative electron and a positive proton of equal charge, situated at, let us say, a distance of a million light years apart. "Does such a universe," Professor Jeans asks, "consist of two free electric charges, or a hydrogen atom, or is it a matter of indifference in which way we regard it? The last alternative can be dismissed at once, for two free charges can not absorb or emit radiant energy, whereas the hydrogen atom can. We see at once that a hydrogen atom must be something more than the sum of its material constituent parts. . . . We now see that the 'something more' which must be added to an electron and a proton to form a hydrogen atom is the mechanism which enables the structure to absorb and emit radiation."

The suggestion that the mechanism, which is the "something

[9] *Atomicity and Quanta*, 1926, p. 92 ff.

more," is the electro-magnetic field is considered by Jeans. A "tube of force" might be conceived to link the electron and proton, were it not that when each atom thus becomes a self-contained system, there is no reason why these atoms should associate themselves into molecules—thus the science of chemistry would be crushed out of existence. However, it seems to me that this is not an insuperable objection. Each continuant has its own superior coördinating force. Atoms and molecules as individuals are self-contained. Chemical affinity may result from the fact that while each continuant, or system of continuants, tends to be magnetically self-contained, the self-containing force, in each case, results from the coöordinating influence of a new type of radiant energy. If so, there are as many dimensions or types of rhythms in the universe as there are emergents. That it is necessary to invoke such a series of levels or dimensions of radiant energy (or wave motions) synchronized to the different continuants of nature seems to me to be indicated by the following consideration.[10]

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BOOK REVIEWS

Begriff und Beziehung. WILHELM BURKAMP. Leipzig: Felix Meiner. 1927. Pp. xi + 306.

One of the most significant questions which have arisen in connection with the recent interest in formal logic and the foundations of mathematics is that concerned with the legitimacy of discussing pure form entirely part from meaning. Obviously the logical calculus proceeds upon such an assumption, and the result is a body of knowledge in which, to use Russell's fitting phrase, "we don't know what we are talking about." Yet in spite of the accuracy of such a logical system and the necessity exhibited in the inter-relation of its elements, any attempted application of it to problems of practical thought leads one to question its actual efficacy as a logical instrument. It is certainly not consonant with common sense to assert that a false proposition implies any proposition whatsoever, both those that are true and those that are false. Such a state of affairs inevitably leads to a question: Isn't this disparity between actual thinking on the one hand, and the rules for correct thinking as given by the logistic on the other, an indication of an illegitimate starting-point on the part of the logistic itself? If form had been derived from meaning and determined thereby, would not some of the difficulties and paradoxes of the formal logic have been avoided?

[10] To be continued in next issue, No. 15.

Dr. Burkamp answers this question in the affirmative. Form and meaning (*Sinn*) are legitimate objects for logical investigation. But the guiding principle in such an investigation is the following: Only after the meaning has been clearly shown, can a form be recognized as correct. Truth is therefore not the inner freedom from contradiction which we demand of every formal system, but a relationship to something outside the pure form itself. In the case of logic this outside element is the meaning. Hence it becomes a legitimate question to ask whether this pure form which has been thought to be logical is really the correct form for logic. Dr. Burkamp's book is a critical investigation into the foundations of the conceptual logic (*Begriffslogik*) from the point of view of this question, in an attempt to determine what is meant by the formal validity of mathematics and logic, the interpenetration of these two fields of study, and the meaning of the *a priori* in general.

The best example of this revised procedure for logical investigation is to be found in the author's discussion of the concept of existence as treated by the logical calculus (Chap. 9). According to the formal interpretation of the universal affirmative proposition, it is to be looked upon as denying the existence of the subject modified by the negated predicate. Stated more simply, the true meaning of an *A* proposition is to be found in its obverse. But since the obverse denies existence, every universal proposition is to be considered as denying existence. Conversely every particular proposition which is a denial of a universal will be a proposition asserting existence. Dr. Burkamp objects to this as an error of formal interpretation; formally the *A* and *E* propositions may be identical, but they obviously do not mean the same. It is possible to make universal affirmative propositions without any direct reference, either of a positive or of a negative kind, to existence. The constructs of science offer many examples of this aloofness from existence. Furthermore, it is equally true that "the denial of both types of general judgments is absolutely undetermined with regard to existence" (p. 166). The error lies in having supposed that the negative general judgment is more fundamental than the positive. This, according to Burkamp, is not true.

The divorcing of form from meaning results in a further misinterpretation with regard to the concept itself as the fundamental logical notion. The concept is not to be looked upon as a merely formal similarity among particulars; it is rather the one similarity which belongs to the specific meaning of the concept, or which constitutes an essential component of the concept (p. 6). Thus a concept is a relational structure (*Relationsgefüge*) which is capable of being specified according to the undetermined differences—a

structure, in other words, which permits passage to the particulars which constitute its membership. Relation thus becomes more fundamental than the concept itself (p. ix) and is the ground upon which all propositional and conceptual logic is constructed. Purely formal truths are therefore truths of relations, truths of order or mathematical truths (p. 59).

The book is divided into five parts, and each part into chapters. The division headings indicate somewhat the nature of the subject-matter: Concept and Proposition; Individual; Existence; Class and Number in the Conceptual Logic; Logic, Mathematics and *a priori*. The author's treatment is largely critical and expository with frequent references to the outstanding writers in symbolic logic. It is characterized by lucidity of expression and is well fortified with examples. The complete list of references is given at the close in the form of a bibliography.

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Influencing Human Behavior. H. A. Overstreet. New York: The People's Institute Publishing Co. 1925. Pp. viii + 296.

One never can tell, but it is just possible that the reading public may discover this latest book by Professor Overstreet. If so, it will be speedily recommended from coast to coast. Few people will recognize it as the work of a philosopher; they will find it too clear, straightforward, and practically applicable for that. I have called it to the attention of various kinds of people, business men, teachers, speakers, writers, laborers, students, etc., and they have united in a chorus of enthusiastic commendation. A book which has proved itself useful to such different types is not a negligible book.

Possibly it is for the same reason not a book which will appeal to the author's professorial colleagues. It is perhaps a little too breezy in style, a little too light (not to say playful) in touch to find favor with academic spirits. And there is no discussion of so-called ultimate matters. Mr. Overstreet believes that we have failed not so much because we have lacked ideals, but because we lacked the knowledge necessary to carry them into effect. It is his aim to assist those who would improve their technique as "skilled artists in the enterprise called life," whatever they may conceive this enterprise to be. "Life is many things," he says, "it is food-getting, shelter-getting, playing, fighting, aspiring, hoping, sorrowing. But at the center of it all is this: it is the process of getting ourselves believed in and accepted." Most men go about this central art of life hit or miss; the author is intent upon helping them to be more intelligent about it.

The general underlying point of view is a form of behaviorism, though not of the uncritical kind. Human individuals "are to be regarded not as mysterious entities, but as more or less unified, more or less modifiable groups of habit systems." He who can find the dominant habit-system in a person, a group, or a nation, and can discover adequate means of controlling it, has attained to profound power over the human situation. That something toward this end can be done by all of us is discussed in two main divisions: one devoted to Introductory Techniques, showing how best to capture attention, arouse interest, make ideas stick, and so get desired action; the other to Fundamental Techniques, dealing with the more deep-going problem of changing human beings. The chapters are intelligently summarized and the theories abundantly illustrated, so that it is as difficult for the reader to lose his way in this book as it is for him to find his way in others one could mention.

Perhaps there is one thing which should cause the thoughtful reader some uneasiness, though perhaps it should not be mentioned unless it could also be discussed, which it can not be in a review of this length. It appears indirectly now and then that Mr. Overstreet is not entirely satisfied with our prevailing theory of life, but the tenor of his book would lead his readers to conclude that our aims are quite satisfactory; all we need is to learn how to "put them across," and that more speedily and triumphantly. It is to be hoped that the influence of the book will not be to further this delusion, but rather to help its readers "to be," as the author hopes, "in some worth-while manner, effective within our human environment."

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Problems in Logic. Charles Henry Patterson. New York: Macmillan Company. 1926. Pp. xii 331.

Whoever puts this text into the hands of students will be spared the painful necessity of defending the venerable concerns of logic regarding the mortality of Socrates and the hoofs of ruminants. Thanks to the development of symbolic logic and inductive logic, the overthrow of medieval formalism is now complete. We are beyond that paradoxical period in the teaching of logic when the "science of thought" found application in the study of logic, but hardly anywhere else. Nevertheless, a second period of "classicism" threatened to engulf us in inductive logic, after Mill. Past and current treatments of inductive logic for students exhibit an astonishing narrowness and sameness in citing examples of inductive method. Nearly all of the examples are drawn from physics and astronomy, hardly any of them later than Helmholtz and Joule. Dr. Patterson's

text exhibits a wealth of examples from many fields of science, some of them very recent discoveries of crucial importance in science.

In Part I the text contains eight chapters (105 pages) on the inductive methods, supplementing the five classic methods of Mill with chapters on "Method of Analogy," "Combined Method of Induction and Deduction," "Circumstantial Evidence." In Part II, a series of chapters are devoted to inductive method in fields heretofore unexplored by the logician: biology, bacteriology, psychology, sociology, economics, physics, astronomy, and law. These chapters are not "padded" with details, and the thread of logical inference which runs through them is skillfully kept in the foreground. The author has been careful to select material which is pedagogically sound, which commands attention because of its appeal to universal human interests. His chapter on biology illustrates this virtue of the book. Here we find logical account taken of such things as the effects of light on color and growth, the mechanisms of hibernation, studies of spontaneous generation, the "language" of bees, the effects of fatigue, and other things. Two chapters are devoted to physics, quite appropriate in view of the fact that in the eyes of most of us this science somehow is the "mother" of all sciences.

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NOTES AND NEWS

We learn with regret of the death on May 25, 1927, of Dr. Ernest Albee, Professor of Philosophy at Cornell University. The Trustees and Faculty of Cornell University have adopted the following resolutions:

"Ernest Albee came from his New England home and schools to Cornell University in 1892, the year following the establishment of the Sage School of Philosophy and his connection with the University was continuous from that time until his death on May 25, 1927. He was appointed instructor in 1892, assistant professor in 1902, and professor of philosophy in 1907. During this long period of service he was for eight years co-editor of *The Philosophical Review* and a frequent contributor to its pages. From the beginning of his association with the Department of Philosophy he was pre-eminent in training of graduate students and in rigorously directing

historical research. Few professors have exercised a deeper or happier influence on graduate instruction. He was profoundly convinced of the fundamental value of the historical approach to philosophy, of its illuminating significance for problems of contemporary thought; to that historical background he applied scrupulously exact methods of inquiry. Into this spirit of precision he persistently and patiently inducted generation after generation of advanced students, and with it he inspired his colleagues.

In addition to many articles on philosophical subjects and reviews of current works on philosophy, he wrote twenty-five years ago "A History of English Utilitarianism," which has become a classic and is still the standard and authoritative exposition of that subject.

Dr. Albee was a man of distinguished manners, of gentle courtesy, temperamentally conservative in his point of view, restrained and precise in word and phase, a searching analyst of ideas and dogmas, but withal a just and appreciative critic of doctrines differing from his own. His career was lived out mainly in the world of books and speculative thought. Although rarely an active participant in administrative or civic affairs, he was an interested and wise observer of their trend. In him were incarnate the scholar's detachment and other-worldliness and, in the finest sense, the aristocracy of learning."

Dr. Harold E. B. Speigt has accepted a Professorship of Philosophy at Dartmouth College. He has been, in the past, Assistant Professor of Logic and Metaphysics at the University of Aberdeen, and Fellow at Manchester College, Oxford. He is now minister at King's Chapel, in Boston.

Étienne Gilson, Professor of Mediæval Philosophies at the Sorbonne, has been appointed Professor of Philosophy at Harvard from September 1, 1927. Professor Gilson will spend the first half of each year at Harvard, the second at the Sorbonne.

Edwin A. Burtt, Assistant Professor of Philosophy at the University of Chicago, has been appointed Lecturer in Philosophy at Harvard University for the year 1927–1928.

Rupert G. Lodge, Professor of Philosophy at the University of Manitoba, will go to Harvard University as Lecturer in Philosophy for the second half of the year 1927–1928.

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Book Reviews. Journals and New Books. Notes and News.

Volume XXIV. No. 9. April 28, 1927.

Our Knowledge of Other Minds. W. W. SPENCER.

What is the Correct Interpretation of Critical Realism? ROY WOOD SELLARS.

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Volume XXIV. No. 10. May 12, 1927.

The Concept of the Symbol (I). CHARLES W. MORRIS.

The Short-Circuiting of Conscious Responses. KNIGHT DUNLAP.

Book Reviews. Journals and New Books. Notes and News.

Volume XXIV. No. 11. May 26, 1927.

The Concept of the Symbol (II). CHARLES W. MORRIS.

The Twenty-eighth Annual Meeting of the Western Division of the American Philosophical Association. A. CORNELIUS BENJAMIN.

Book Reviews. Journals and New Books. Notes and News.

Volume XXIV. No. 12. June 9, 1927.

Also the Emergence of Matter. ALFRED H. LLOYD.

Book Reviews. Journals and New Books. Notes and News.

Volume XXIV. No. 13. June 23, 1927.

Rignano's Hypothesis of a Vital Energy and the Prerequisites of a Sound Theory of Life. F. S. C. NORTHROP.

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